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## University of Bath

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# Options to supply the UK steel demand and meet the CO<sub>2</sub> targets

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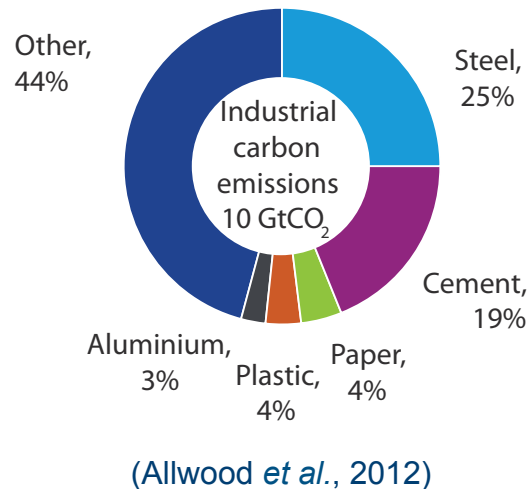
Jonathan Cullen, University of Cambridge

Julian Allwood, University of Cambridge

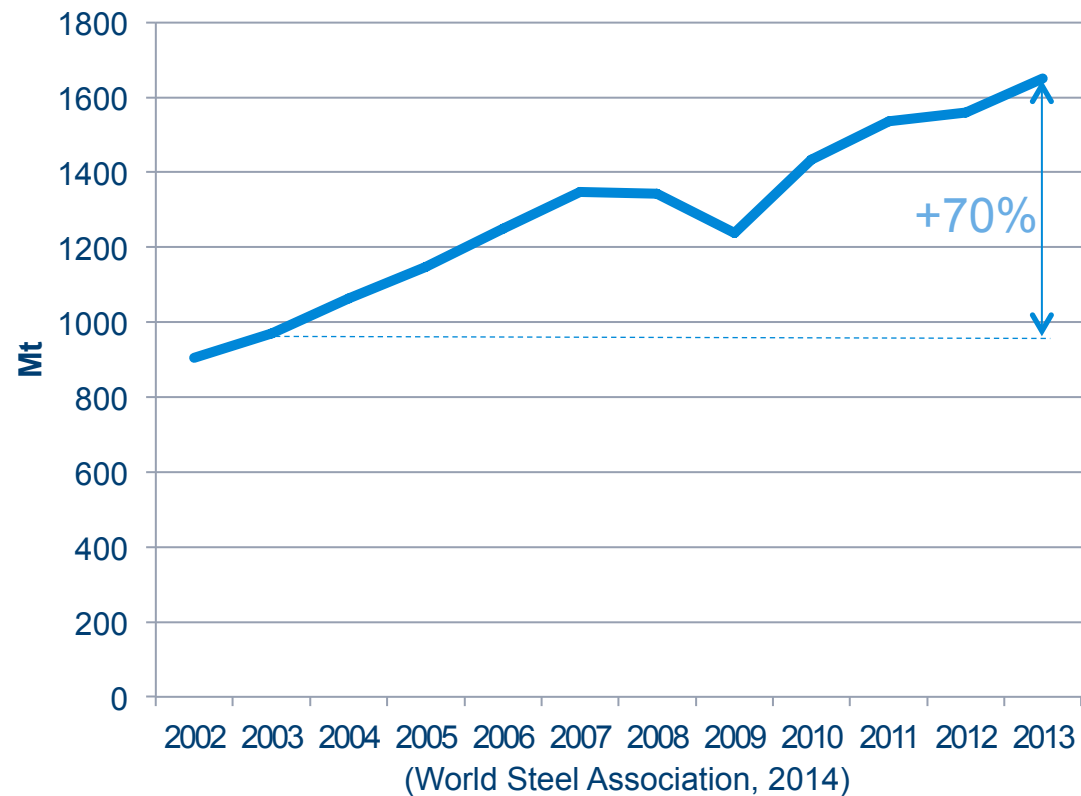
ISIE Conference 2015, Guildford, UK  
July 10<sup>th</sup>, 2015

# Steel global production and impacts

## Global industrial CO<sub>2</sub> emissions, 2005



## Global crude steel production



# Reducing steel industrial emissions and supply future demand

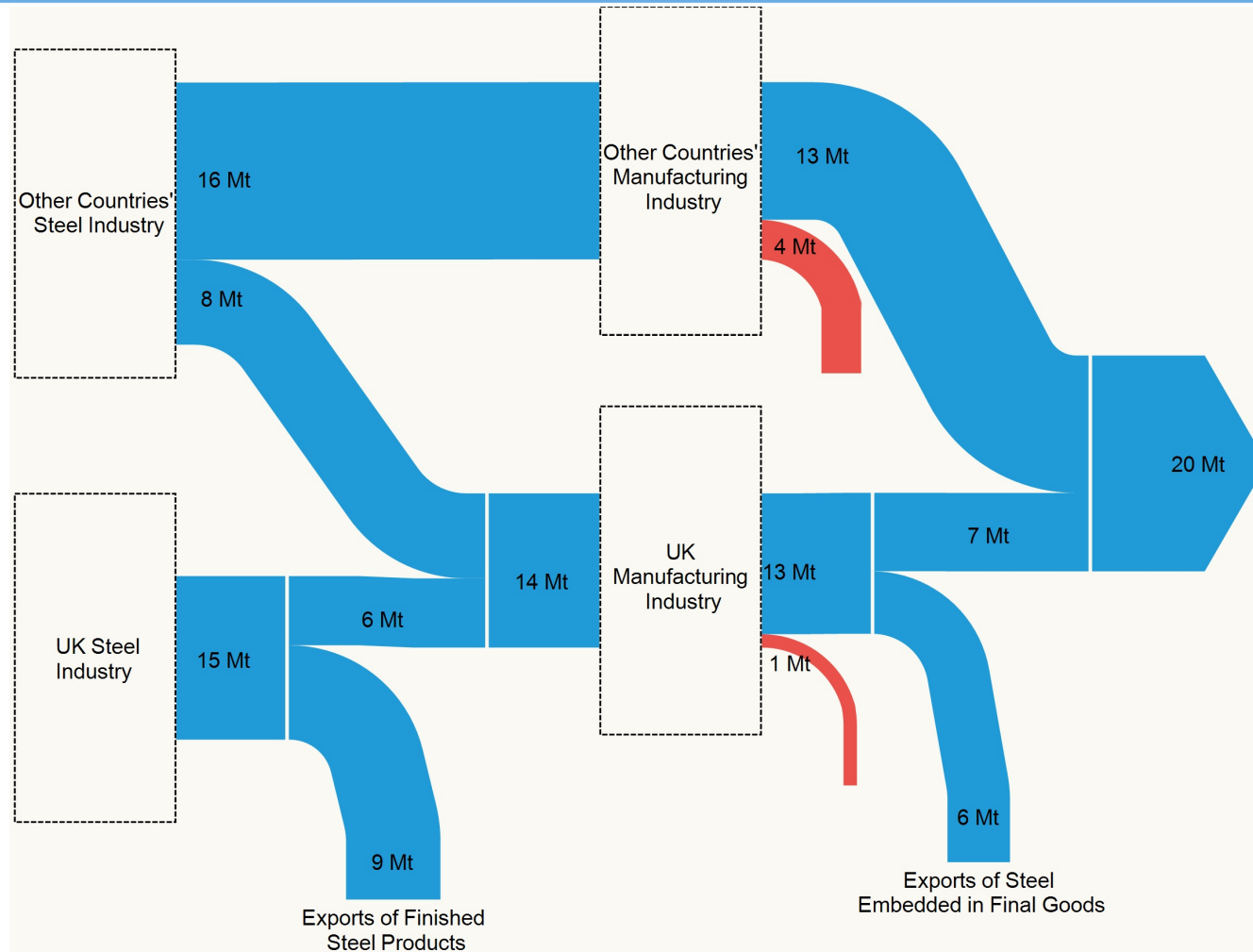
How can steel industry emissions be reduced?

1. Switching to more efficient production routes;
2. Increasing the efficiency of current production routes;
3. Reducing steel demand.

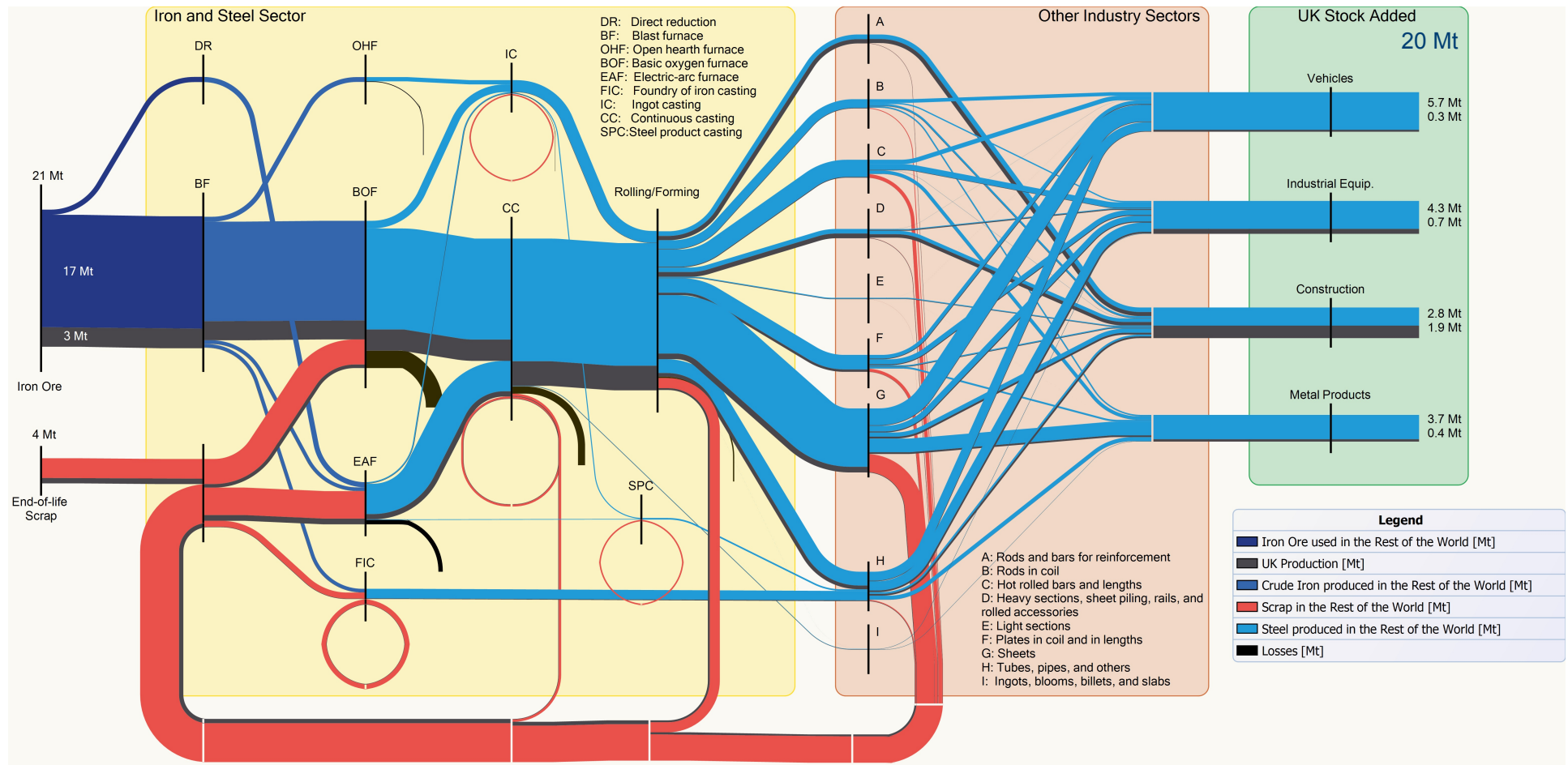
In the UK:

- The Government has committed to a reduction of UK GHG emissions to 80% of the 1990 levels by 2050.
- **How to supply future demand for steel in the UK and meet this climate target?**

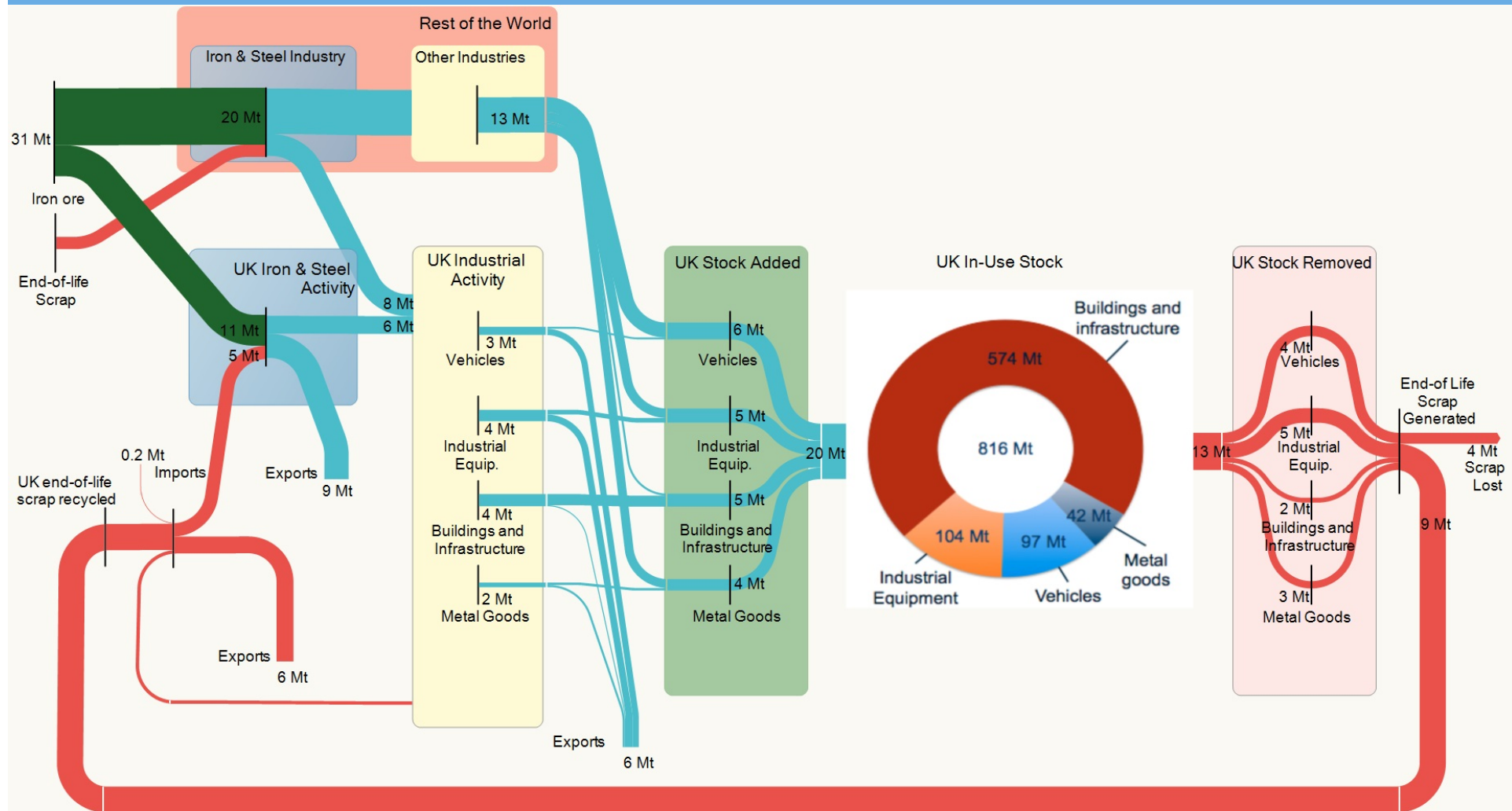
# Steel flow to supply the UK demand, 2007



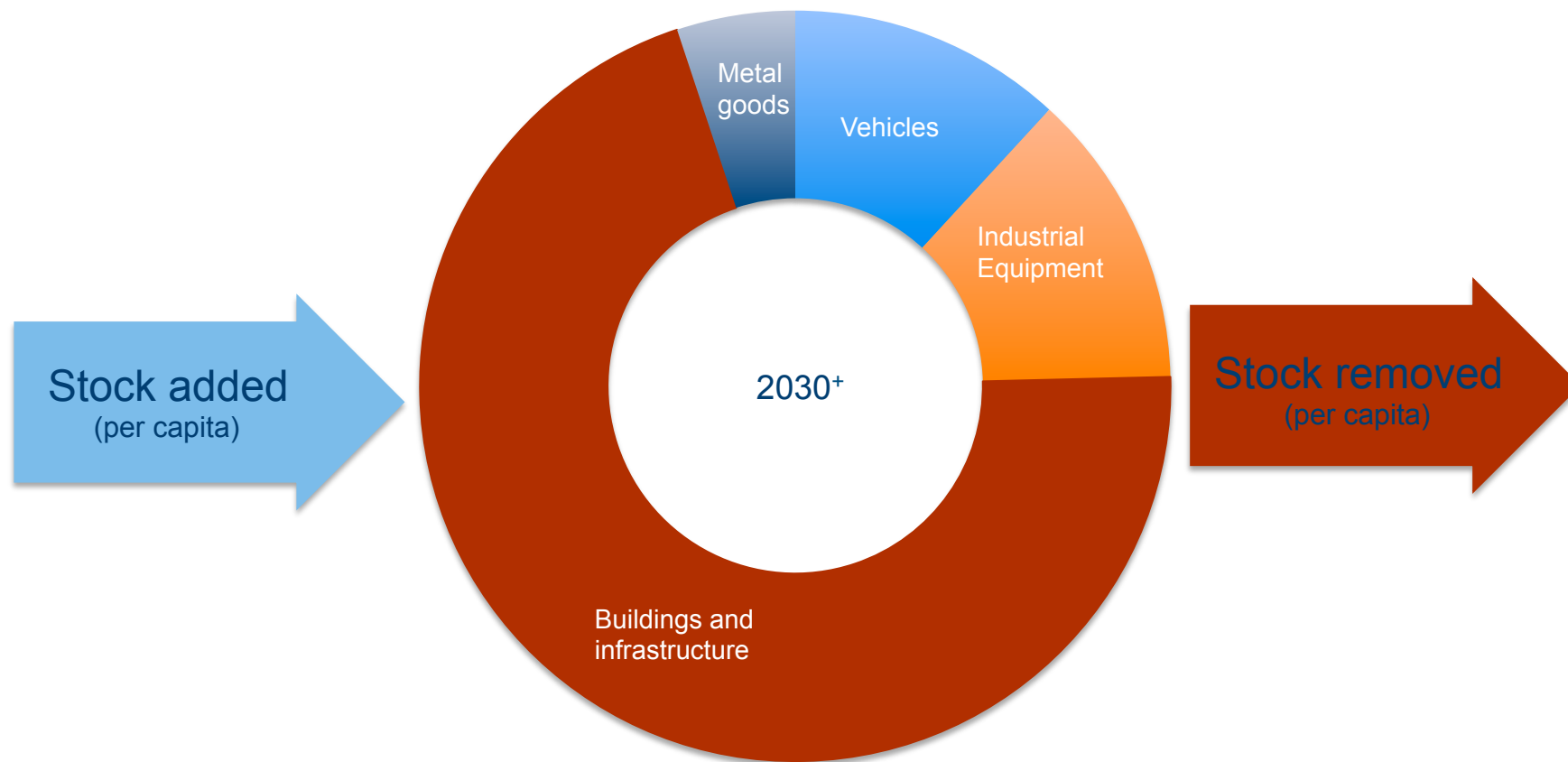
# Steel flow to supply the UK demand, 2007



# Steel added / removed from in-use stock, UK 2007



# In-use stock saturation

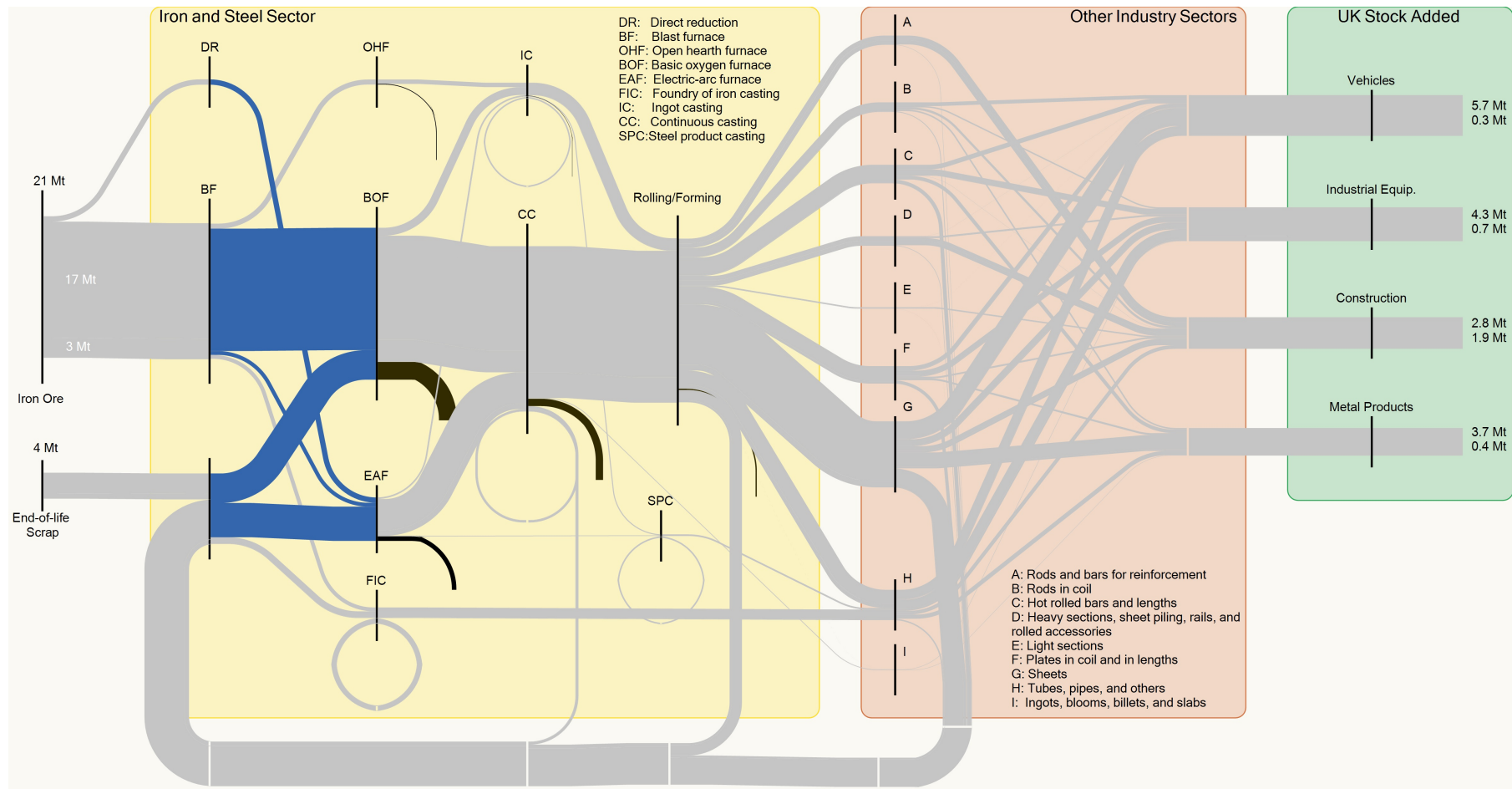




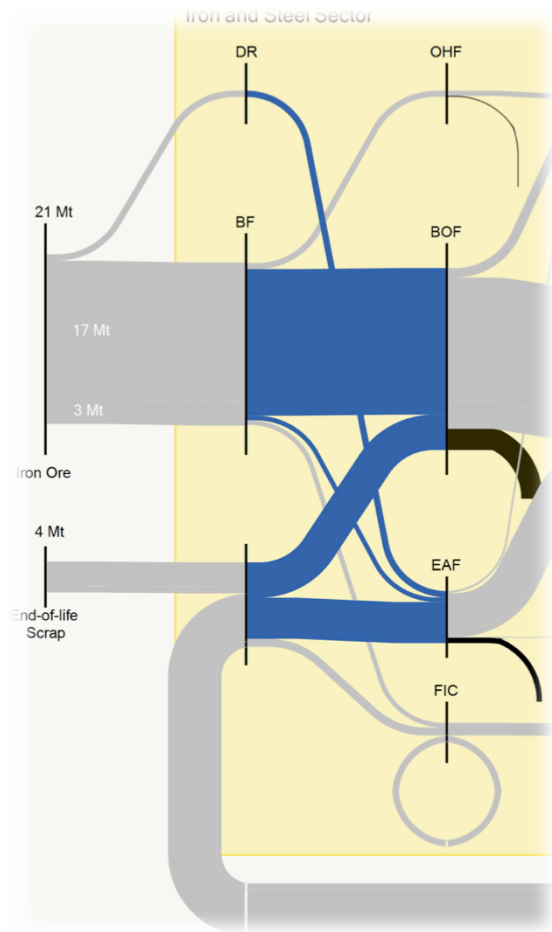
# Estimating future UK crude steel demand

Product categories	Saturation stock [tonnes per capita] (Pauliuk et al., 2013)	Average lifetime [years] (Pauliuk et al., 2013)	Demand for new steel additions to stock [Mt]	Demand for crude steel [Mt]
Vehicles	1.3	20	5.4	7.4
Industrial equipment	0.9	30	2.6	3.4
Buildings and infrastructure	10.0	75	13.3	16.4
Metal goods	0.6	15	3.3	4.6
<b>Total</b>	<b>12.8</b>		<b>24.5</b>	<b>31.7</b>

# Options for future UK steel production



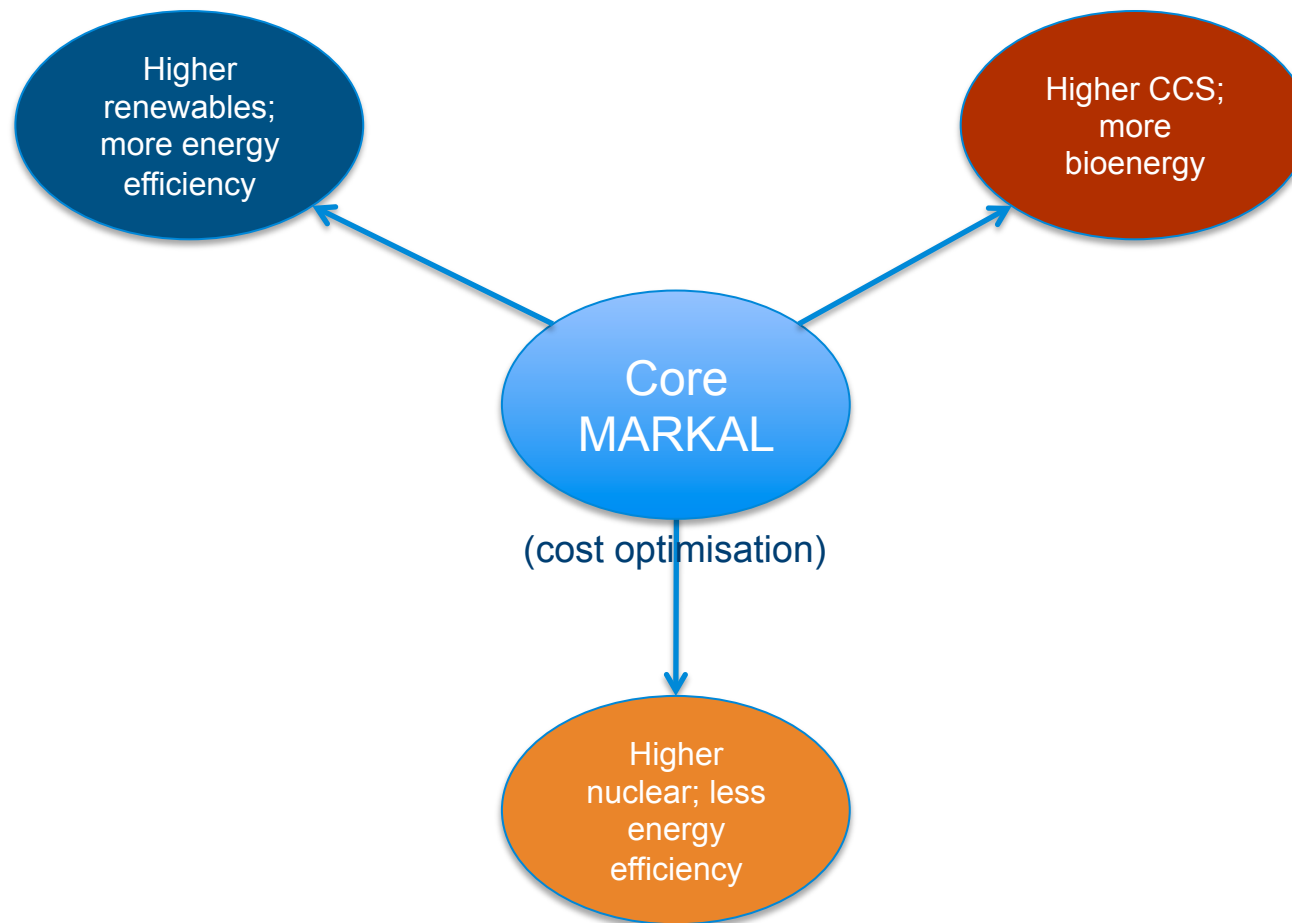
# Options for future UK steel production



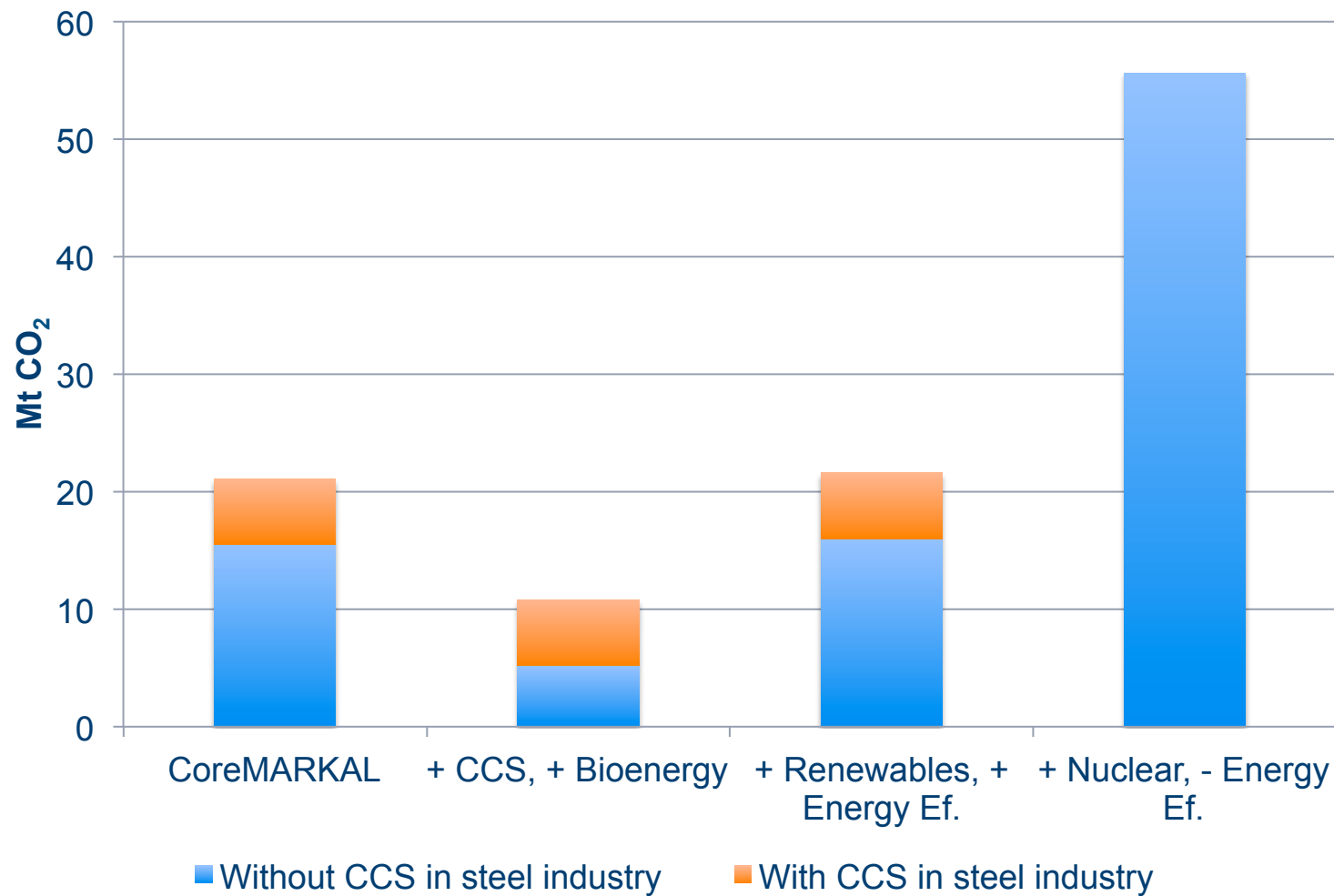
Iron sources	A	B	C	D	E
Hot metal from BF	67%	84%	5%	—	—
DRI	—	—	—	25%	50%
Scrap	33%	16%	95%	75%	50%

# UK Carbon Plan Pathways

4 pathways for a low carbon future:



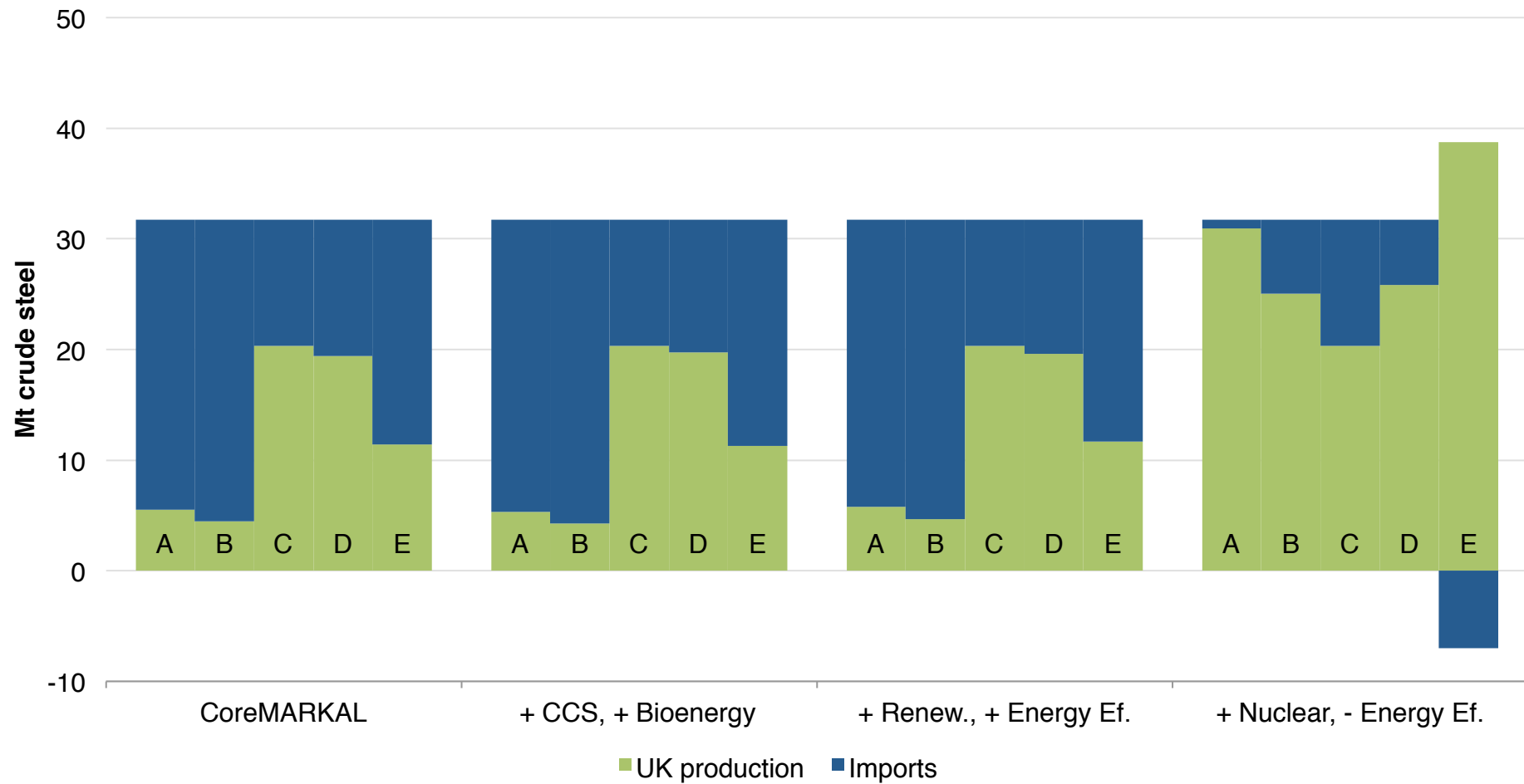
# Emissions for the UK steel industry in 2050



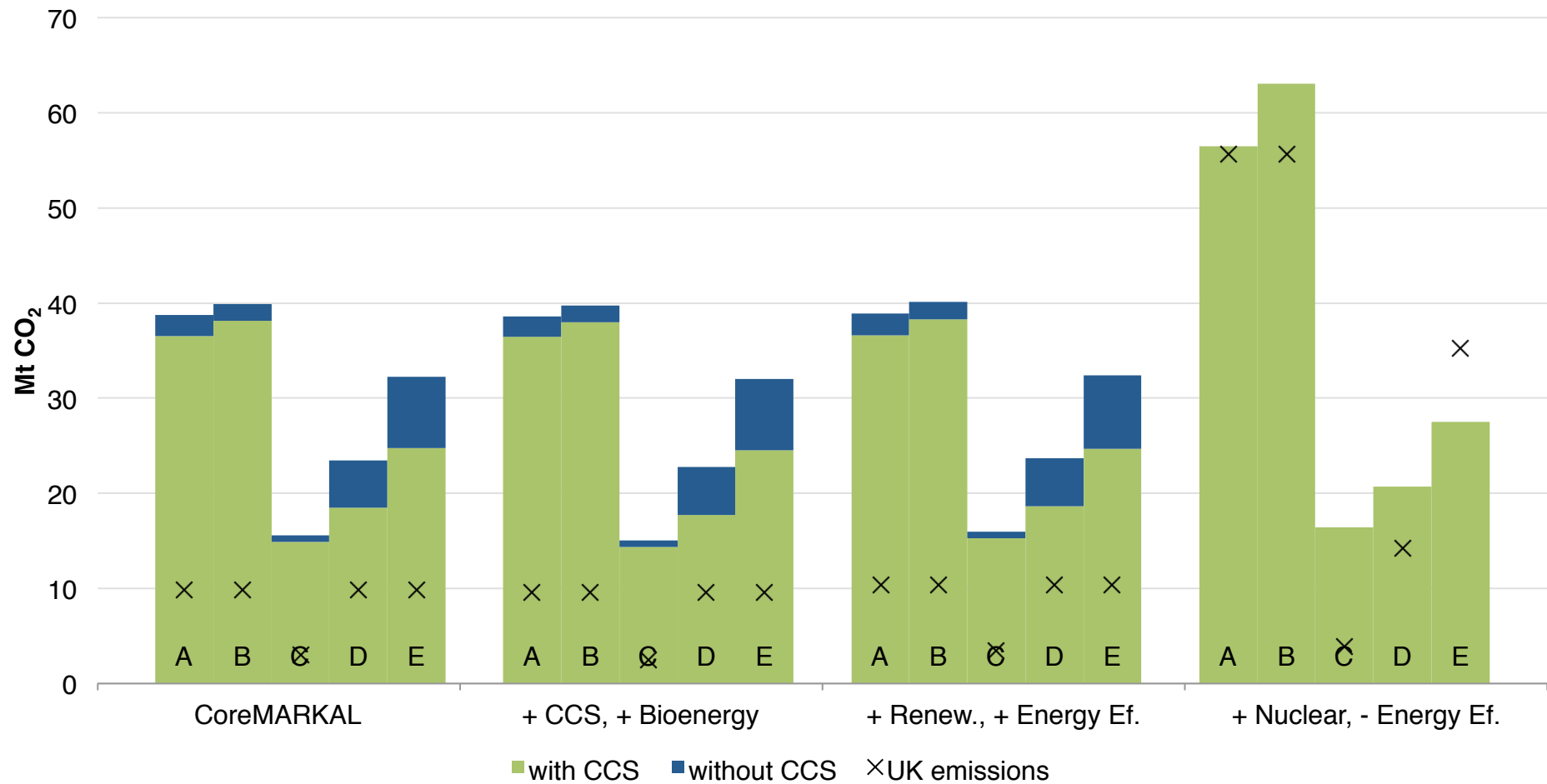
# UK Steel scenarios / Energy pathways

	CoreMARKAL	High CCS, more bioenergy	High renewables, more energy efficiency	High nuclear, less energy efficiency
<b>A: Current Scrap / BF – BOF</b>	<p>Total CO<sub>2</sub> emissions (in UK or other countries) required to supply UK steel demand in 2050, in terms of:</p> <ul style="list-style-type: none"> <li>• UK production / steel imports required;</li> <li>• Use of CCS in UK steel industry;</li> <li>• Levels of UK electricity decarbonisation;</li> <li>• Share of end-of-life scrap recycled;</li> <li>• Products' lifetime.</li> </ul>			
<b>B: BF – BOF</b>				
<b>C: 95% Scrap – EAF</b>				
<b>D: 75% Scrap / 25% DRI – EAF</b>				
<b>E: 50% Scrap / 50% DRI – EAF</b>				

# UK steel production / steel imports required

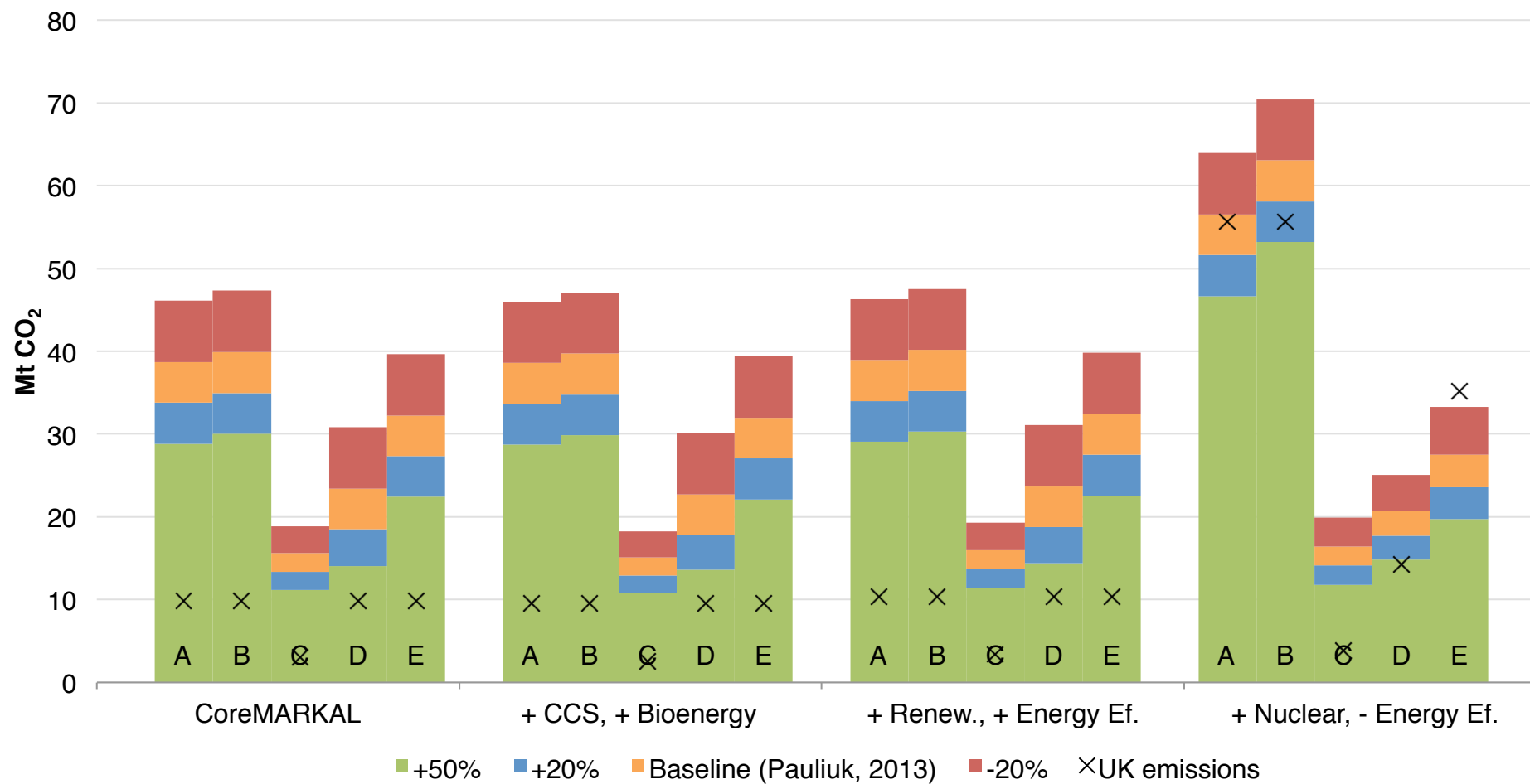


# Use of CCS in the UK steel industry





# Change in products' lifetime in the UK



# Conclusions

Best solutions to **minimise global CO<sub>2</sub> emissions** caused by steel purchased in the UK and to **reduce dependence on imports**:

- Maximise domestic end-of-life scrap in UK steel production;
- Deployment of direct reduced iron – electric arc furnace route in the UK;
- Extending products' lifetime in the UK.

# Options to supply the UK steel demand and meet the CO<sub>2</sub> targets

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